

permeable rocks does not appeal. His conclusions as a follower of water by sheer hard climbing and exploration underground are supported by the very varied results of borings made near one another in beds regarded as porous by the engineer. M. Martel believes, with much justice, that subterranean rivers do not etch out their own way; they are determined by pre-existing crevices, the *diaclases* of Daubrée. In the case of limestone, solution obviously widens the original fissure; but it must have been generally recognised that the long-continued dominance of the joint-system is again and again revealed in the plans of sinuous caves.

M. Martel, however, does not give geologists much credit for observing a relation between the direction of surface-streams and the fissured structure of a country; but we cannot help remembering the account of the Drava and Gail system in the first volume of Suess's "Antlitz der Erde," and the exposition by Molyneux and Lamplugh of the Batoka Gorge of the Zambezi. In the case of Mosi-oa-tunya, however, M. Martel seems satisfied with the somewhat catastrophic views of Livingstone. We must admit that an examination of our ordinary text-books reveals an unfortunate silence on this question of fissures and stream-erosion; but surely M. Martel is inclined to exaggerate (p. 42) the differences between his views and those of colleagues like Lugeon, Kilian, and de Martonne. He is accustomed to move adventurously in narrow rift-like ways, along the floors of ravines and their counterparts underground; but he cannot wish us to return to the antique view of valleys as gaping fissures in the crust. On a tilted peneplain the courses of streams are at first uncertain; they are controlled merely by the general slope. When they have worked down into the surface of solid rock, they at once begin to be guided by the joints, the lines of weakness. The walls of the ultimate valleys are due to erosion; the general ground-plan is often determined by that of the joints, the walls of which are practically in contact until the streams begin to work.

The surface-waters then cut downwards. By seepage they become subterranean, and the *diaclases* prove still more effective in the underworld. The details of caves and of disappearing and reappearing streams are never monotonous to M. Martel; but the frequent photographic representation of them may pall a little on the geological or engineering reader. We must admit that the pictures here given, to the number of three hundred, are fascinating and often very impressive. In some cases, as in those of the cañon of Olhadibie in the Basses-Pyrénées, they result from very recent exploration.

The discussion of the origin of water in the Chalk

(p. 366) raises important engineering considerations. Mr. R. L. Cole has recently dealt with this matter as regards the south of England ("The Power User," June 1922, p. 97), and he treats the body of the Chalk as providing little opportunity for flow. M. Martel, in his descriptions of "lapiaz" or "lapiés" (p. 531), shows well how water penetrates a limestone surface and how it proceeds to ramify below. His remarks on the use of the divining-rod (p. 749) are philosophic and reserved; he looks for a very extended series of trials made on a consistent plan. The power of divination, if it exists, resides in the operator and not in the instrument used. He shows, among other interesting matters, how the sinking of artesian wells was known to dwellers on the edge of the Sahara centuries before Moorish engineers were invited to find water in Artois. The ease with which subterranean water may be contaminated is attested by grim instances (p. 767) of the slow decomposition of corpses interred on the battlefields of 1914-18, and by the infection during a whole year of the spring of Gerbéviller in Lorraine.

GRENVILLE A. J. COLE.

Statics, Dynamics, and Hydrodynamics.

- (1) *Elementary Statics of Two and Three Dimensions.* By R. J. A. Barnard. Pp. vii+254. (London: Macmillan and Co., Ltd., 1921.) 7s. 6d.
- (2) *Theoretical Mechanics: An Introductory Treatise on the Principles of Dynamics, with Applications and Numerous Examples.* By Prof. A. E. H. Love. Third Edition. Pp. xv+310. (Cambridge: At the University Press, 1921.) 30s. net.
- (3) and (4) *Idromeccanica Piana.* By Prof. Umberto Cisotti. Parte Prima. Pp. xii+152. Parte Seconda. Pp. viii+155-373. (Milano: Libreria Editrice Politecnica, 1921.) Lire 24 and 32 respectively.

(1) **P**ROF. BARNARD'S new book makes an excellent text-book for the higher years in pass degree courses and for the first part of honours courses in applied mathematics. The scope is that generally expected, a chapter on forces in three dimensions being included. In treatment the book is orthodox and safe, so orthodox in fact that centres of gravity are left to quite a late chapter, as if the finding of centres of gravity were an aim in itself. The proof of the vector property of couples is very effective.

A chapter is added on vectors in space, use being made of the vector notation, and the student is referred to the author's "Dynamics" for a fuller treatment. The modern student of mechanics and physics cannot afford to be quite ignorant of vector methods and notation, and Prof. Barnard is performing a useful

service by including them in his books, even if only in the form of an afterthought.

(2) Prof. Love's "Theoretical Mechanics" is a book that serious students of dynamics cannot be without: the discussions of the principles are illuminating, and the collections of examples are useful to both teacher and pupil. Only a few changes have been made in the recently issued third edition. Perhaps it is permissible to suggest that the book would be immensely more useful if it partook of the nature of a text-book, and included a much larger number of worked examples. The student's main difficulty in dynamics is not in learning the comparatively restricted number of ideas and methods given in the usual honours courses, but rather in obtaining the necessary experience for using these ideas and methods successfully in the problems presented by nature. By far the most effective help that can be given him is that contained in a judiciously selected and carefully graduated series of worked problems, where the efficiency value of each process is made evident.

As the author emphasises the importance of the fundamental principles, the volume would be the right place for a brief account of relativity in dynamics. To leave this latest phase of modern scientific reform to the physicist and the philosopher is a mistake that applied mathematicians should endeavour to counteract.

Publishers no doubt know their business and do not need the advice of academic men. A protest must nevertheless be raised against excessive prices. The price of this new edition will prevent its sale among just those young students whose mechanical ideas the author wishes to influence.

(3) and (4) The study of two-dimensional problems is of great interest in several branches of applied mathematics, as, for instance, in potential theory, electricity, and hydrodynamics. It often happens that when a three-dimensional problem of importance cannot be solved, the two-dimensional case is amenable to modern mathematical methods and its solution sheds much light on the general problem. This has been the case particularly in hydrodynamics.

The present volumes are the first two parts of a treatise on two-dimensional hydrodynamics. Part I. gives the theory of the complex variable and conformal representation, which is followed by a statement of the equations of motion of a fluid in two dimensions. Problems with boundaries consisting of free stream lines only, and with boundaries consisting of fixed barriers only, are then discussed. Part II. deals with jets and other problems, involving both fixed and free boundaries, while Part III. will deal with wave-motion.

Of the different types of problems discussed by Prof. Cisotti, perhaps the most interesting is that of

discontinuous motion of fluid past a fixed barrier—a problem that has some bearing on the modern subject of aerodynamics. When the barrier is plane, and the motion is assumed to be irrotational, with free stream lines, the problem has been solved by the use of what constitutes one of the most elegant processes of mathematical reasoning. Curved barriers, however, have so far defied solution, except in the sense that when a solution is suggested one can obtain equations which define the barrier appropriate to the solution. The problem of the curved barrier may almost be described as one of the classical problems of hydrodynamics. Several interesting cases have been discussed, in particular by Prof. Cisotti himself, Villat, and others.

The ordinary text-book process of solving two-dimensional problems in hydrodynamics is to seek a relation between the complex variable that represents the geometry of the actual motion and the complex variable involving the velocity potential and the stream-line function. An intermediary variable, which is essentially representative of the velocity vector, is often useful. In dealing with discontinuous motion past barriers consisting of plane surfaces, a further intermediary variable is needed, based on the Schwartz-Christoffel transformation: the problem is then reduced to quadratures.

For curved barriers, however, this is insufficient, and a new type of transformation has been found necessary. The essential idea of this transformation is to make the barrier correspond to a semicircle in a new Argand diagram. The general solution of the problem is then defined in terms of a Taylor expansion, and the choice of the coefficients in this expansion determines any particular curved barrier. Elegant formulæ exist for finding the pressure components on the barrier, and the line of action of the resultant pressure, but an explicit statement for the latter has not yet been published.

This process, due to Levi-Civita and others, can be made to yield numerical results of considerable interest. Brillouin has given the working for a set of barriers defined by a certain choice of the coefficients in the above-mentioned series. Further, by a process of approximation, circular and elliptic barriers admit of numerical solution.

Prof. Cisotti's résumé of the progress in this problem during the last fifteen years is masterly, and of great use to researchers in the subject. It seems, however, that the footnote on p. 179 is based on a misapprehension. Brillouin has given the conditions that must be satisfied if the free stream lines are to have finite curvature where they leave the barrier. The author urges that these conditions are not necessary. He is right, but Brillouin does not mean that these conditions

are to be satisfied always. As a matter of fact, the problems in which Brillouin's conditions are satisfied are those which have the greatest bearing on aerodynamical research. Further, Brillouin's conditions can be used to elucidate the rather puzzling question of the difference between barriers which are defined by the same mathematical curves, but of different extents, as *e.g.* circular barriers of different angular extents.

These two volumes can be highly recommended to all who are interested in recent developments in the mathematics of two-dimensional hydrodynamics.

S. BRODETSKY.

Our Bookshelf.

Register zum Zoologischen Anzeiger. Begründet von J. Victor Carus. Herausgegeben von Prof. Eugen Korschelt. Band xxxvi.-xl., und *Bibliographia Zoologica*, vol. xviii.-xxii. Pp. iv+695. (Leipzig: Wilhelm Engelmann, 1922.) 280 marks.

ALL who have had occasion to use the bibliography which is issued with the "Zoologischer Anzeiger" know that much trouble and loss of time are involved in consulting the volumes not yet indexed in one of the five-yearly "Registers." They will welcome, therefore, this belated volume, which indexes, mainly, the papers published from 1909 to 1911, including also a few from 1912 and a good many of earlier date which had previously escaped notice. It is compiled according to the same plan as its predecessors. Each paper is indexed under its author's name, with an abbreviated title and a citation of the volume and page of the bibliography where the full reference will be found. There are also cross-references under systematic names where these are mentioned in the title, or in the brief notice appended to the entries in the bibliography, and all new generic names are separately entered.

It was the opinion of Herr Heinrich in Mr. H. G. Wells's story of "Mr. Britling" that "the English do not understand indexing." It may be only because of this national defect that we find the plan of the "Bibliographia Zoologica" cumbersome and inconvenient as compared with that of our own "Zoological Record." The volume before us is only an index to an index. It requires us to take down at least one other volume from the shelf before we can find the reference we want. It includes neither a subject index nor a geographical index, and the systematic references are far from adequate for the needs of the systematist. All bibliographies, however, are useful, if only because none of them is perfect, and certainly no zoologist can afford to neglect the "Bibliographia Zoologica." At the present time, when the obstacles to the international diffusion of knowledge are only slowly being removed, the need for such works and the difficulties in the way of compiling and publishing them are alike great. It is to be hoped, therefore, that this volume will soon be followed by others cataloguing the literature of more recent date.

W. T. C.

Report of the Canadian Arctic Expedition, 1913-18. Vol. xii.: *The Life of the Copper Eskimos.* By D. Jenness. (Southern Party, 1913-16.) Pp. 277. (Ottawa: Department of the Naval Service, 1922.) 50 cents.

THE report of the Canadian Arctic Expedition, 1913-18, is planned to include at least sixteen volumes. This, the ethnographical volume, is the work of Mr. D. Jenness, a graduate of the University of New Zealand, who received his anthropological training at Oxford, and is already known as the author of an important book entitled "The Northern D'Entrecasteaux." Mr. Jenness lived for some years in the tents and snow-houses of the Eskimo, and though he says little of his personal difficulties, the companionship of his Eskimo hosts and their strange food must have been a trying experience. With the help of a devoted missionary, the Rev. H. Girling, who unfortunately died of pneumonia at Ottawa in 1920, he has been able to prepare a singularly valuable account of life in all its phases among the Copper Eskimos, whose headquarters are on the Coppermine River. Fortunately for them, this land lies in the track of the Great Caribou migration when the herds move northward in the spring. They are then able to collect stores of meat and skins, and from this and the seals and fish, which are abundant, their wants are supplied. Formerly their hunting was done with bows and arrows, but these are now replaced by rifles, and it would be well for the Canadian Government to consider whether the use of improved weapons should not be controlled in the interests of game preservation.

The book is full of curious facts and is illustrated by photographs and maps. "With the influx of traders and missionaries into the country the conditions of life are fast changing. Famine looms less in the foreground, but in its place European diseases are threatening the health of the communities, and bid fair to rival all other causes in their effect on the death-rate." The suggestion that a period of quarantine and medical examination should be enforced on all strangers entering the Eskimo territory certainly deserves serious consideration.

The Scope of School Geography. By Dr. R. N. Rudmose Brown, O. J. R. Howarth, and J. Macfarlane. Pp. 158. (Oxford: Clarendon Press, 1922.) 5s. 6d. net.

THE authors have briefly reviewed the scope of school geography, maintaining two dominant themes throughout, one the essential unity of the subject, the other the scientific character of its data and its methods. "Geography, properly speaking, has a definite viewpoint of its own and is not a mosaic of loans from other subjects." "The teaching of geography is no less the work of a specialist than the teaching of chemistry or history."

The authors have adhered, and for school purposes perhaps correctly, to the statement that geography may be regarded as the interaction between man and his environment; but even for the purpose of this book it might have been desirable rather to have stated the broader and deeper truth that geography has as its field the distribution of the interrelations of many phenomena of which human activities form but one.